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SOME OUTSTANDING SAFETY RECORDS IN THE MINING AND ALLIED INDUSTRIES

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BY

R. G. Warncke and Stanley M. Walker

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

SOME OUTSTANDING SAFETY RECORDS IN THE MINING AND ALLIED INDUSTRIES[1]

By R. G. Warncke[2] and Stanley M. Walker[3]

INTRODUCTION

The United States Bureau of Mines was created by an act of Congress in 1910 as a governmental agency to work, on a national scale, toward reducing the huge annual loss of life in the production and processing of the Nation's minerals. From 1906 to 1910, inclusive, nearly 2,500 miners lost their lives in 84 major explosion disasters, and more than 13,000 suffered fatal injuries from all causes in the coal mines of the United States. Also, conditions in the metal and nonmetal mines were proportionately hazardous during this period, and the total loss of life in all mines and quarries exceeded 3,000 annually and approximately 250,000 workers suffered serious injuries.

Under these conditions it is readily understandable why Congress took notice of this "high cost of mining", and from the investigations and hearings of the day emerged the Bureau of Mines charged with the prevention of accidents and the preservation of the health of all those engaged in the mineral industry; this has continued to be a most important part of the work of the Bureau.

Throughout its existence the Bureau of Mines has had no legal authority of enforcement, except during war years, when enforcement necessary to the national security was given to it. The Bureau believes that persuasion, with factual evidence, is the proper and best way to obtain compliance with the safety suggestions made by its engineers and scientists. There is no panacea for accidents, nor will any single "approach" instill safety consciousness in all workers, and without it accidents will occur--and occur again. To persuade men to work safely, numerous forms of appeal are required to reach the various temperaments of workers in many types of mines operating under diverse conditions.

JOSEPH A. HOLMES SAFETY ASSOCIATION

One of the most consistently helpful agencies in connection with the safety work of the Bureau for the past two decades has been the Joseph A. Holmes Safety Association, which the Bureau has sponsored since organization of the association in 1916, when 24 leading national organizations representing the mining, metallurgical, and allied industries banded together to commemorate the safety achievements of the first director of the Bureau of Mines, Dr. Joseph A. Holmes, who died in 1915, and to assist in reducing the number of accidents in the industry.

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[2] Mining engineer, Safety Branch, Bureau of Mines, Washington, D. C.
[3] Mining engineer, Safety Branch, Bureau of Mines, College Park, Md.

The aim of the association has been to publicize, by giving suitable awards, records of outstanding attainments in safety in the mineral industry. These awards place before the industry and the public the data upon which the awards are based, showing by actual accomplishment that many mining operations, in spite of their inherent hazards, can be, and frequently are, conducted as safely as those in any other industry in the Nation.

Until 1927, awards were issued only for heroic action or services of individuals, but in 1927, when Daniel Harrington began his 21-year tenure as secretary of the Association, awards were made for exceptional performance of individual mines and quarries, companies or departments of companies, plants, and individuals connected with the mineral industry. In all, 1,645 awards for meritorious safety records have been made during the 21 years' 1927 to 1948.

DISTRIBUTION OF AWARDS

Of the 1,645 awards for outstanding safety accomplishment issued since 1927, coal mining received 649, metal mining 352, and individuals in the coal-mining industry received 312 awards. Table 1 shows the distribution of the awards by industries, and table 2 shows the distribution of awards by States.

SAFETY PROGRESS

The mineral industry is widely diversified and has many branches, in which economic and physical problems differ in so many ways that only a few are common to all. In a discussion of the outstanding records achieved in mining and allied industries, consideration must be given to this diversified nature of mining in order to evaluate properly the records established.

Certain safety hazards are common to all branches of mining, but some branches have serious hazards peculiar only to them. Coal mining has the combustible-gas and dust-explosion hazards; many underground metal mines have the inherent hazards arising from work in places of higher or lower elevations, such as raises, winzes, and stopes; the petroleum industry works with highly flammable and sometimes toxic oil and gas, and quarries and open pits have the hazards of high, unscalable faces. Most of these are present only occasionally in any other branch. Likewise, various hazards are found in the separate operations of one type of mining, even within the same area, because of different physical conditions and methods of mining.

Because the hazards and risks are not comparable in all branches of the mining industry, the outstanding safety records of each branch are considered separately. In this paper no attempt is made to compare the record of one branch with that of another or one record with another, but rather to point out those that are outstanding in their own branch or classification as shown in the tabulations.

TABLE 1. - Safety awards, by industries

Industry	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941[1]	1946	1947	1948	Total
Coal mines or companies......	2	4	5	10	8	28	33	40	40	52	33	28	66	67	81	67	37	48	649
Metal mines or companies......	1	3	3	4	9	11	19	9	13	24	19	20	32	34	37	55	31	28	352
Nonmetal mines or plants.........	-	2	1	1	7	1	4	6	-	1	2	4	1	4	5	3	4	-	46
Petroleum plants or companies...	-	-	-	-	3	3	2	-	7	6	6	9	8	9	15	24	33	26	151
Quarries.........	1	-	-	-	3	-	-	1	-	-	1	2	13	7	9	8	3	10	58
Associations.....	-	-	-	1	2	1	-	1	-	1	-	1	-	-	-	-	-	-	7
Mills and smelters.............	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	-	-	-	6
Cement plants or companies......	-	-	-	-	-	-	-	-	-	3	8	1	2	1	1	1	2	1	20
Miscellaneous....	-	-	-	-	-	1	-	2	5	-	-	-	1	3	2	-	-	-	14
Individuals:																			
Coal mining....	-	-	2	-	3	8	17	9	6	13	4	44	31	38	51	60	14	12	312
Metal mining...	-	-	-	1	2	2	1	-	-	-	-	-	-	1	1	-	1	5	14
Nonmetal mining	-	-	-	-	1	1	-	1	-	-	-	-	-	-	-	-	-	1	4
Petroleum......	-	-	-	-	-	-	-	-	-	-	1	1	-	-	2	-	-	-	4
Miscellaneous..	-	-	-	-	-	-	-	-	-	1	1	-	1	2	-	-	-	3	8
	4	9	11	18	38	57	76	70	71	101	75	110	155	167	206	218	125	134	1,645

1/ No awards were made during the war years, 1942-1945.

TABLE 2. - Safety awards by States

Alabama	77	New Mexico	13
Arkansas	3	New York	13
Arizona	20	North Carolina	8
California	16	Ohio	32
Colorado	63	Oklahoma	29
Connecticut	1	Pennsylvania	348
Florida	5	South Carolina	1
Georgia	2	Tennessee	12
Illinois	69	Texas	54
Indiana	11	Utah	27
Kansas	13	Virginia	37
Kentucky	60	Washington	6
Louisiana	40	West Virginia	278
Maryland	9	Wisconsin	14
Michigan	128	Wyoming	59
Minnesota	152	Alaska	1
Missouri	9	Companies operating in various States	26
Montana	7		
Nebraska	1		1,645
Nevada	1		

Collectively, the mining industry is considered to be the most hazardous of the major industries of the United States, and it has long been criticized because of its high injury rate, particularly in connection with fatalities. These criticisms are largely justified when comparisons are made with other major industries, although consideration must always be given to the fact that mining is beset by numerous inherent hazards, some of which present difficult problems to handle. According to the reports of the National Safety Council, which included both coal and noncoal mines under mining until 1945, mining had an injury-severity rate for 1944 about seven times greater than the average of the 38 major industries of this country. In 1945, accidents in mining were classified to cover coal mining and noncoal mining separately, at which time noncoal mining and coal mining ranked 39 and 40, respectively, among the 40 industries listed. Coal mining had a severity rate of 11.94, more than twice the 5.56 rate of noncoal mining, whereas the average of the 40 industries was only 1.16. For 1946, noncoal and coal mining again ranked next to last and last, respectively, of the 41 major industries. However, in comparing the injury rates of other industries and those of the mineral industries, consideration must be given to the fact that a mine worker encounters essentially all the risks of workers in other industries plus numerous additional hazards found only in mining.

As dark as this picture may seem for the mining industry, there are many bright spots to show that progress is being made in placing safety in its rightful position in the operation of mines. Few people realize that the mining industry has been the pioneer in advancing safety in American industry; and many, possibly most people, are under the impression that very little has been done to alleviate the many hazardous conditions inherent in mining. This impression is created largely by the hysteria connected with mine disasters that cause multiple loss of life, which occur from time to time, particularly in coal mines. A major disaster, especially if it is an explosion, usually causes a flood of adverse publicity, and many of the short-comings of operation and maintenance are exploited and very frequently magnified, with the result that the public receives the impression that the mining industry has little regard for the safety of its workers. These occurrences always overshadow the sincere efforts of those who, over the years, have tried and have succeeded in making mining a much safer industry than it was in the past, and certainly little or no publicity is given to mines that have made outstanding safety records. Many of the safety achievements of the mineral industries compare with, and several surpass, those of far less hazardous industries, and this paper gives some information concerning those records.

The presentation of awards to mines, companies, and individuals draws attention to their specific performance in the field of safety, but only by inference is the general improvement in accident reduction in the industry as a whole drawn from these records. That these awards do exemplify the steady improvement in safety in mining during the past two decades is proved by accident statistics. Although public opinion is frequently lead to believe the contrary, tremendous strides have been taken by the mining industry to make the mines in this country safer places in which to work.

That the coal-mining industry has progressed in preventing accidents is evident from the fact that it has reduced its fatality rate much faster and farther than has the entire country. In 1911, the fatality rate of the United States per 100,000 population was 84.7, and the present estimate places the rate in 1946 as 70.8, which is 16.4 percent lower than the 1911 rate. The coal-mine fatality rate in 1911 was 365 per 100,000 employed, and the estimated rate for 1946 is 213, or a reduction of 41.6 percent below the 1911 rate; hence, coal mining has reduced its fatality rate 2.7 times as much or as rapidly as has the entire country. On a fatality rate per-million-tons-produced basis, the percentage reduction is even greater, being 69.3 percent lower in 1946 than in 1911. The rate in 1911 was 5.35 fatalities per million tons of coal produced and in 1946 it was 1.64. Evidently, the coal-mining industry over the past 36 years has progressed much farther in the prevention of fatal accidents to its workers than has the country for the entire population.

Another measure of improved coal-mining conditions is to be found in the reduction of major mine disasters. In the 10 years 1906-1915, there were 143 disasters that took a toll of 4,210 lives; in the next 10 years 100 disasters killed 2,128 workers; from 1926 to 1935, 77 disasters caused 1,477 fatalities, and in the most recent 10-year period, to 1945, 56 major disasters cost 1,072 lives. Thus, by 10-year periods, the occurrence of disasters has been reduced steadily, and the most recent period shows a 60.9-percent decrease from the first 10-year period for which statistics are available, and the loss of life through these disasters has been decreased 74.5 percent over the same periods.

The noncoal mines of the nation also have shown great reduction in the number of fatal and nonfatal accidents since 1911, when 695 persons were killed as against 112 in 1945 and 26,577 nonfatal accidents occurred as contrasted with 8,090 in 1945. The fatal-accident rate per 100,000 persons employed in noncoal mines in 1911 was 4.45, against the 1.62 rate of 1945; the nonfatal rate per 100,000 employed in 1911 was 170.27, against the 117 rate of 1945.

Similar improvement has been made in the quarries and underground limestone mines, and although in the 10-year period 1911-1920 an annual average of 164 men were killed and 9,299 men were injured, in the 10-year period 1936-1945 these figures had been reduced to 76 men killed and 5,446 injured each year, a decline of 53.5 percent in the number of fatal injuries.

One can hardly question that mining is much safer now than it was 10, 20, or 30 years ago. Much of this improvement may be credited to those mines, companies, and individuals with outstanding safety records to whom Joseph A. Holmes Safety Awards have been given; not so much for the effect of their low accident figures upon the over-all accident statistics as for the excellent example they set to others in their field or branch of the industry; and the rivalries induced have caused many mines and plants to take a more progressive view of safety work in an attempt to emulate their successful neighbors.

The cost of accidents is coming to be generally acknowledged as a direct production cost, and frequently efficient low-cost production accompanies active accident prevention. Some of the companies with outstanding safety records have proved this by continuing in operation when nearby mines, mining similar products under comparable conditions but with many costly accidents, have been forced to shut down. The cost of accidents may not have been the sole cause of closing, but it certainly was an important factor in increased production costs. This, therefore, is one reason why publicity through awards is considered by the Joseph A. Holmes Safety Association so helpful in attaining greater safety in mining.

Safety Awards

The 1,645 awards are only a small percentage of the number of records studied and screened before the awards are made. Several hundred records are submitted annually for consideration by members of the Safety Award Committee, who, after reviewing all known conditions, select the best records for awards. The records of all those selected are again verified by inquiries before the awards are issued, thus establishing an authentic record.

The records appearing in this paper were compiled solely from a study of the files and records of the Joseph A. Holmes Safety Association, as they were the only available source of information as to the safety performance of the mineral and allied industries. Some safety records may possibly surpass those that follow, but they were not available for study.

RECORDS OF INDIVIDUALS

Miners usually are fatalistic, as are many of those engaged in management, and generally believe that a certain percentage of men working underground will sustain injuries eventually, many of them fatal. This fatalism is gradually being superseded by the idea that by using the right amount of the right kind of effort mine accidents of all kinds can be reduced greatly, even though they probably will continue to occur.

Awards were made to 342 individuals for exceptional records of safe work or supervising the safe work of others without a lost-time injury or fatality based on man-hours worked, tonnage produced, or length of service. The record indicates that 194 individuals have worked 50 or more years in and around mines without suffering an injury that caused the loss of a day's work. This is an excellent record for any kind of work, particularly for mine workers, and the question arises: Why can't others do as well?

The following table shows the number of workers in each group of safe years:

Years worked	Number of workers
50-54	109
55-59	55
60-64	20
65-69	5
75-79	5

All the men receiving these awards worked in coal and noncoal mines in several States and under virtually all types of working conditions.

In 1946, a large coal-mining company in western Pennsylvania submitted detailed data concerning 197 employees who had worked more than 35 years in and around coal mines without a lost-time injury; 17 worked 50 to 58 years, 19 from 45 to 50 years, 60 from 40 to 45 years, and 101 from 35 to 40 years. This is a total of 7,939 work-years, or approximately 16,000,000 man-hours without a lost-time injury for this group of men.

Excellent records, although perhaps not as outstanding as the above, have been made by the workers at several other coal mines. Achievements of this type tend to disprove the idea that all underground workers are sure to be injured eventually. Very often a mine can be made only as safe as its workers permit. Evidently the individuals just mentioned believed in working safely and practiced safety throughout their working careers, and unquestionably this paid large dividends to the employers as well as to the employees and their families.

OUTSTANDING SAFETY RECORDS OF INDIVIDUAL MINES AND COMPANIES

In selecting outstanding safety records in the mining industry, a definition of what constitutes outstanding safety records is in order. The industry is large and scattered and has many branches, some of which are somewhat similar, whereas others differ greatly. A record that might be considered outstanding in one branch or type of mining would be only fair or even poor in other types. A fairly representative picture of outstanding records is obtainable by placing mines or companies having more or less similar methods and conditions in the same classification. In general, two types of records are given under each classification: (1) Those established on a no-lost-time basis and (2) those based on periods without fatalities. Also, consideration is given to production achieved with minimum injuries and fatalities.

In the following tables, the duration of the period, the number of men employed, and the man-hours of exposure are all considered either singly or together in selecting the outstanding records. The amount of material mined in metal mining is given where available, whereas in coal mining the tonnage of coal produced was generally used in selecting the records, because in most cases reasonably accurate data on man-hours of exposure were unobtainable.

METAL MINING

During the past 20 years, metal mines in many sections of the United States have established very creditable safety records, but relatively few have been brought to the attention of the Joseph A. Holmes Safety Association as compared to those from the Lake Superior region. For this reason, the iron-ore mines and mining companies in the Lake Superior region received more than 80 percent of the awards issued to metal mines and metal-mining companies of the United States.

Table 3 gives some records of underground mines that have operated long periods without lost-time injuries. These mines have operated 1 to nearly 5 years without a single day being lost by any worker owing to injuries. Several of these mines have had more than one period of accident-free operation, any one of which would be outstanding, and some have had periods of several months to a year with only one injury.

A few small mines are included in this table to show that a mine with a small number of employees can be worked as safely as a larger mine, and it is notable that the mine with the smallest number of employees has the longest injury-free record. This is unusual, as the small mine is rarely accident-free; in fact, the small mine usually has many more accidents, proportionately, than a large one. The records of these small mines indicate that small mines can be operated safely if both management and workers co-operate in a safety program.

It would be difficult to select the most outstanding record in table 3, as each is an outstanding achievement and stands by itself.

Table 4 gives some of the outstanding records of open-pit iron mines that have operated without lost-time injuries. These mines have operating periods free of injuries ranging from 2 to 11 years, whereas one mine operated over 17 years with only two lost-time injuries.

The Hull-Rust mine of the Oliver Iron Mining Co. has a remarkable record in this group, having worked 2 years and 7 months with a total of 1,814,996 man-hours and handled nearly 20,000,000 tons of material without a single day being lost owing to accidents.

Four of the open pits in this group have a small number of employees, and again it is shown that small mines can be operated safely. These mines worked from over 5 years to nearly 12 years without an accident, and the man-hours of exposure during this period compare favorably with the larger mines when the number of employees is considered. The Richmond mine worked 30 employees 11 years without an injury, and in a 19-year period the mine had a severity rate of only 0.01.

TABLE 3. - Underground iron mines having long periods of no lost-time injuries

Mine	Operator	Location	Period	Duration	No. men employed	Exposure man-hours	Ore mined, tons	Remarks
East Vulcan.	Penn Iron Mining Co.	Vulcan, Mich.	1/26/27 to 1/26/29 3/3/38 to 12/5/39	2 yr. 21 mo.	199 197	925,000	424,109	Last fatality 3/22/29.
Newport.	Youngstown Mines Corp.	Ironwood, Mich.	11/10/43 to 3/6/45	16 mo.	299	867,012	791,711	
Cliffs shaft..	Cleveland-Cliffs Iron Co.	Ishpeming, Mich.	8/6/39 to 8/31/40	1 yr.	392	880,642	587,985	
Buck.....	Pickands Mather & Co.	Caspian, Mich.	11/2/44 to 11/10/45 11/16/45 to 11/15/46	1 yr. 1 yr.	358 299	834,347 517,375	778,788 471,825	No fatality 11/22/31 to 8/31/41.
No. 5 shaft..	Montreal Mining Co.	Montreal, Wis.	5/28/30 to 12/31/33	1313 days	-	661,520		Drove 12,060 ft. drifts and crosscuts, and 5,154 ft. raises
No. 4 shaft..	Montreal Mining Co.	Montreal, Wis.	9/11/29 to 1/1/31	477 days	-	623,520		
James...	Pickands Mather & Co.	Iron River, Mich.	4/13/37 to 4/8/41	4 yr.	65	597,278		No fatality 1/9/29 to 3/19/43.
Hiawatha No. 1..	Hanna Iron Ore Co.	Iron River, Mich.	2/18/35 to 1/1/37	22-1/2 mo.	124	518,242		No fatality 7/1/30 to 1/1/42.
Leonidas	Oliver Iron Mng. Co.	Eveleth, Minn.	2/5/42 to 12/31/46	59 mo.	48	482,899		
Godfrey.	Oliver Iron Mng. Co.	Hibbing, Minn.	3/1/41 to 4/15/42	22-1/2 mo.	206	484,528	678,649	
Soudan..	Oliver Iron Mng. Co.	Soudan, Mich.	2/8/41 to 1/19/42 11/1/46 to 2/29/48	11 mo. 11 days 1 yr. 4 mo.	240	474,118 696,241		Two periods.

TABLE 4. - Some open-pit iron mines that have outstanding records of no lost-time injuries

Mine	Operator	Location	Period	Duration Years	Duration Months	No. men employed	Exposure, man-hours	Iron ore mined, tons	Remarks
Hull-Rust	Oliver Iron Mining Co.	Chisholm, Minn.	7/4/38 to 2/25/41	2	7	275	1,814,996	19,928,509	
Mahoning.	Pickands Mather & Co.	Hibbing, Minn.	12/1/39 to 12/31/42	3	1	251	1,579,988		
			11/1/44 to 12/31/47	3	2	171	1,050,401	8,105,966	
Danube...	Pickands Mather & Co.	Coleraine, Minn.	1/1/42 to 3/31/45	4	3	192	1,305,910		
Missabe Mountain	Oliver Iron Mining Co.	Virginia, Minn.	7/10/34 to 3/16/38	3	8	105	1,404,711	10,647,933	
Embarrass	Pickands Mather & Co.	Biwabik, Minn.	1/1/44 to 12/3/45	2	0	292	1,188,157	9,169,325	
Scranton.	Pickands Mather & Co.	Hibbing, Minn.	8/1/37 to 12/31/41	4	5	111	1,190,332	9,481,024	
			6/1/30 to 12/31/36	6	7	41	750,859		
Biwabik..	Pickands Mather & Co.	Biwabik, Minn.	5/1/41 to 7/31/46	5	3	74	761,632	4,169,847	
			8/1/37 to 7/1/40	2	11	74			
Richmond.	Richmond Iron Co.	Palmer, Mich.	1/1/28 to 1/1/39	11	0	30	435,385		Severity rate 1928-47, 0.01
Albany...	Crete Mining Co.	Hibbing, Minn.	11/1/31 to 4/30/40	8	6	46	760,000		Mine idle 1932-33-34
			6/11/40 to 12/31/41	1	7	47	275,705		
			3/1/23 to 4/30/40	17	2	46	2,283,529	5,380,955	Only two lost-time accidents.
Volunteer	Pickands Mather & Co.	Palmer, Mich.	5/4/35 to 12/31/47	12	8	24	645,476	2,632,342	No fatality in 21 years.
Rouchleau	Oliver Iron Mining Co.	Virginia, Minn.	12/19/45 to 9/20/47	1	9	390	1,546,211	14,417,984	

So many of the open-pit iron mines in the Lake Superior region have worked one or more years without fatality that it was difficult to select the outstanding records; however, any record of operation over 15 years without a fatality should be considered outstanding. The mines in table 5 were selected because of their exceptionally long records without fatalities and not on the basis of exposure, but two companies that have established good records in only a few years were selected because of their exceptionally large number of man-hours of exposure. The Cleveland-Cliffs Iron Co. worked 3,225 employees for nearly 2 years, with a total of 12-1/2 millions man-hours, without a fatality, whereas the Hibbing-Chisholm District of the Oliver Iron Mining Co. worked over 6-1/2 million man-hours with 1,183 employees in 2 years 9-1/2 months without a fatality.

Five of these mines have also established outstanding injury-free records and appear in table 4. Man-hours or tonnage handled were not available for two mines appearing in table 5, but both of them operated 21 years without a fatality. The Mahoning mine handled nearly 47 million tons of material in 15 years, 8 months, whereas the Scranton mine handled more than 27 million tons in 23 years 3 months, both without a fatality.

These excellent safety records, made in both the underground and open-pit iron mines of the Lake Superior district, show the effectiveness of well-rounded safety programs. This district has the most active section of the National Safety Council, devoted to the prevention of accidents in the mining industry. Safety meetings are held monthly and are attended by officials, supervisors, and workmen. The interest in safety has permeated the whole working force from management to worker, and these mines were operated in accordance with printed safety rules, with well-guarded machinery, personal protective equipment, and innumerable safety devices, plus a force of well-trained mine workers and officials.

Table 5 also shows two outstanding records of safe operations of open-cut copper mines; the record of the Utah Copper Co. in handling 75 million tons of material in 11,000,000 man-hours in a 3-year period without a fatality is exceptional.

The safety achievements of two bituminous-coal strip mines also are listed in table 5, as the records are so good as to be entirely out of the ordinary. Moving 92 million tons of overburden in 6 years, 10 months without a fatality in Mine No. 11, United Electric Coal Co., Illinois, is a feat difficult to surpass. The vast difference in tonnage of overburden handled - 92 million by Mine No. 11 in Illinois and 15 million by the Rosebud mine in Montana, with nearly the same tonnage of coal produced - is a good illustration of the different conditions encountered in mining the same mineral at different places.

Table 6 contains statistics on underground metal mines that have operated long periods without fatalities and includes the records of mines producing different kinds of ore in various sections of the United States. A study of this table indicates that safety is not bound by geographic limits but is obtainable by the application of suitable efforts throughout the industry, as shown by the outstanding records made in various sections of the country.

TABLE 5. - Open-pit iron mines that have operated long periods without a fatality

Mine	Company	Location	Duration		No. men employed	Exposure, man-hours	Iron mines, tons	Remarks
			Years	Months				
Albany......	Pickands Mather & Co.	Hibbing, Minn.	23	10		3,240,644	11,233,861	
Scranton....	Pickands Mather & Co.	Hibbing, Minn.	23	3	110	4,337,597	27,114,130	
Biwabik.....	Pickands Mather & Co.	Biwabik, Minn.	21	3		2,679,663	13,892,887	
Hibbing-Chisholm Dist.	Oliver Iron Mining Co.	Hibbing, Minn.	2	9-1/2	1,183	6,540,641	34,254,803	
	Cleveland-Cliffs Iron Co.	Ishpeming, Mich.	1	11	3,225	12,579,698	10,078,632	
	Synder Mining Co.	St. Louis County, Minn.	16	6		11,034,066	19,564,398	
Mahoning....	Pickands Mather & Co.	Hibbing, Minn.	15	8			46,844,221	
Richmond....	Richmond Iron Co.	Palmer, Mich.	21					
Wakefield...	Hanna Iron Ore Co.	Wakefield, Mich.	21	1-1/2				

Open-cut copper mines that have operated long periods without a fatality

							Copper-ore mined tons	
New Cornelia Branch.....	Phelps Dodge Corp.	Ajo, Ariz.	4	4	550	5,828,736	55,035,380	
	Utah Copper Co.	Bingham Canyon, Utah	3	-	1,400	11,000,000	75,000,000	

Bituminous-coal strip mines that have operated long periods without a fatality

Mine No. 11.	United Electric Coal Co.	DuQuoin, Ill.	6	10	6,041,748 tons coal - moved 92,000,000 tons overburden.			
Rosebud.....	Northwestern Improvement Co.	Colstrip, Mont.	8	0	7,320,000 tons coal - moved 15,356,000 tons overburden - 3,044,208 man-hours			

TABLE 6. - Underground metal mines that have operated long periods without a fatality

Mine	Operator	Location	Period	Duration, years	No. men employed	Exposure, man-hours	Tons ore	Kind of ore
	Miami Copper Co.	Miami, Ariz.	7/29/29 to 12/31/35	6-1/2	602	5,593,776	15,582,119	Copper
Climax....	Climax Molybedenum	Climax, Colo.	9/24/43 to 12/31/45	1-1/4			7,777,978	Molybdenum
Empire....	Empire Star Mines Co., Ltd.	Grass Valley, Calif.	6/13/27 to 1/1/34	7-1/2	244	4,027,648		Gold
Menominee Range Mines (9 mines)...	Pickands Mather & Co.		11/22/31 to 12/31/38	7	502	5,854,047	3,201,516	Iron
East Vulcan...	Penn Iron Mining Co.	Vulcan, Mich.	3/22/29 to 12/31/41	11-3/4	196	4,523,447	2,892,217	Iron
Newport...	Youngstown Mines Corp.	Ironwood, Mich.	9/1/27 to 12/31/33	6-1/3	268	3,701539	2,667,739	Iron
Greenwood.	Inland Steel Co.	Ishpeming, Mich.	1/1/31 to 3/31/46	15-1/4	104	3,474,716		Iron
Armour No. 2........	Inland Steel Co.	Crosby, Minn.	9/19/23 to 1/11/32	8-1/3		3,040,900	2,161,028	Iron
Lark......	U.S. Smelting, Refining & Mining Co.	Lark, Utah		4-1/2	323	2,670,759		Lead-zinc
Eureka....	Tennessee Copper Co.	Copperhill, Tenn.	1925 to 12/31/38	14			2,218,558	Copper
Wauseca...	Mineral Mining Co.	Iron River, Mich.	1910 to 1930	21	50			Iron
Davidson Ore Mining Division.....	Pittsburgh Coke & Chemical Co.	Iron River, Mich.	8/1910 to 4/21/43	32-3/4	51		2,179,356	Iron

One remarkable record in this group is that of the Miami Copper Co., Miama, Ariz., in raising 15-1/2 millions tons of ore from an underground mine with a total of 602 employees working more than 5-1/2 million man-hours in a 6-1/2-year period without a fatality. The Empire mine, Grass Valley, Calif., a gold-producing property, worked 7-1/2 years, or more than 4 million man-hours, without a fatality. The Climax Molybdenum Co., Climax, Colo., mined 7-3/4 million tons of ore in 1-1/4 years without a fatality. The records of these three mines, producing different ores under entirely different working conditions, illustrate the remarkably good results obtainable from active safety programs.

The records of iron-ore mines in this group are outstanding, not so much on the basis of man-hours worked but on the duration of the record. An excellent example of long-time safe operations of a small underground metal-mining property is that of the Davidson Ore Mining Division, Iron River, Mich., which worked the mine from its opening in 1910 until it was closed in 1943, nearly 33 years, and produced a little over 2,000,000 tons of ore without a fatal injury.

CEMENT PLANTS AND QUARRIES

Some of the most outstanding safety records established in the mining industry have been made by cement plants and quarries. These records are almost entirely the result of the continuous safety campaign carried on for over 20 years by the Portland Cement Association and its member plants. The activities of this association and the marvelous safety achievements resulting there from constitute a concrete example of the effectiveness of a well-coordinated and consistently applied accident-prevention program.

In 1923, when the Portland Cement Association inaugurated its definite program, not one of the plants operated any considerable period without a lost-time injury. Since that date, because of continual safety training, a safety record of less than 1,000 injury-free days is not considered a very great accomplishment. Many of the member plants have worked more than 1,000 days, several more than 3,000 days without a lost-time injury, and more than half of the 125 or more member plants have had one or more years of operation without a lost-time injury.

Although numerous records made in this branch of the mining industry can be considered outstanding, table 7 lists some of the plants that have better than ordinary outstanding records. These include both large and small operations; the larger were selected for both their records of man-hours of exposure and the duration of the period, whereas the smaller operations were selected chiefly because of the duration of the safety record.

TABLE 7. - Cement plants and quarries having outstanding records of no lost-time accidents

Plant	Operator	Location	Period	Duration		Men employed	Exposure, man-hours	Remarks
				Years	Months			
Iola..........	Lehigh Portland Cement Co.	Iola, Kans.	9/9/26 to 6/28/39	12	9-1/2		3,579,883	Produced 7,259,550 bbl. cement.
Cement Plant and Quarry	Ash Grove Lime & Portland Cement Co.	Louisville, Neb.	12/26/34 to 5/19/41	6	5	180	2,218,676	
Gray..........	Medusa Portland Cement Co.	York, Pa.	2/20/37 to 3/1/48	11		90	2,284,032	
	Nazareth Cement Co.	Nazareth, Pa.	4/17/29 to 4/21/32	3	0	240	2,138,037	Blasted 226 tons of explosives.
Ironton.......	Alpha Portland Cement Co.	Ironton, O.	12/8/26 to 7/28/33	6	6	150	2,008,208	Produced 3,644,321 bbl. cement.
Dononah.......	Tennessee Coal, Iron & Railroad Co.	Bessemer, Ala.	1/14/37 to 3/19/42	5	2	114	1,321,367	Produced 3,689,632 tons of dolomite.
No. 2 Quarry..	Pennsylvania Dixie Cement Corp.	Clinchfield, Ga.	8/28/31 to 12/31/45	14	4	24	661,395	
Dexter No. 4..	Pennsylvania Dixie Cement Corp.	Nazareth, Pa.	1/1/25 to 12/31/38	13	2		771,642	
Birmingham....	Lehigh Portland Cement Co.	Birmingham, Ala.	8/1/27 to 1/1/40	12	5	24	623,089	
Lone Star..... Plant	Lone Star Cement Corp.	Dallas, Tex.	7/17/33 to 1/1/47	14	5-1/2	25	469,093	
Sandt's Eddy..	Lehigh Portland Co.	Sandt's Eddy, Pa.	12/10/43 to 3/1/48	4	3	-	1,524,600	Produced 3,941,000 bbl. of cement.
Cape Girardeau	Marquette Cement Mfg. Co.	Cape Girardeau, Mo.	6/20/41 to 3/1/48	6	9	-	4,351,742	Best-known record.
Sugar Creek	Missouri Portland Cement Co.	Independence, Mo.	5/21/31 to 8/8/47	16	3	-	1,324,986	Longest known period.

The outstanding safety record, considering both length of time and man-hours or exposure in the cement industry (believed to be the best in the entire mining industry), is that of the Iola Plant of the Lehigh Portland Cement Co., Iola, Kans. This plant worked 12 years 9-1/2 months with an exposure of 3,579,883 man-hours in producing more than 30,000,000 sacks of cement without a single lost-time injury. This record is believed to be so exceptional that many years may pass before it is equaled. The best record, considering exposure, is that of the Cape Girardeau plant of the Marquette Cement Manufacturing Co. at Cape Girardeau, Mo., which operated without a lost-time injury for nearly 7 years with over 4,350,000 man-hours of exposure. The Sugar Creek underground limestone mine was operated for over 16 years without a lost-time injury while working 1,324,986 man hours. This is the outstanding record for long period of safe operation. One of the smaller plants, the No. 2 Quarry, Clinchfield, Ga., worked 24 men over 14 years without the loss of a single day from injuries.

The Ironton mine, Alpha Portland Cement Co., Ironton, Ohio (not included in table 7, as it is an underground mine), worked 6 years, 4 months with a total of 617,907 man-hours without a lost-time injury. Although not connected with the cement industry and not included in table 7, but with a record that is worthy of note, No. 5 limestone mine, an underground limestone mine operated by the Tennessee Coal, Iron & Railroad Co., Muscoda, Ala., established one of the best records for any underground, nonmetallic, noncoal mine in working 919,887 man-hours in 5 years, 8 months without a lost-time injury.

COAL MINING

Coal mining is not only the most hazardous branch of the mining industry, but it is considered the most hazardous of the major industries, not only in the United States but in all countries that produce coal in quantity. The rates per million man-hours or per thousand persons employed for both fatalities and nonfatalities in either anthracite or bituminous-coal mines exceed by far the rates found in other branches of the mining industry. Although the rates in coal mining may never be reduced to those of the other branches of mining, definite progress is being made in safety, and the fatality rates for 1946 were the lowest in the history of the industry. While there has been a steady decline in the rates for a number of years, they are still too high, and a more determined effort on the part of both management and labor is needed for a greater reduction in number of accidents.

Coal mining has changed greatly in the past two decades, and the older hand methods of mining have been largely supplanted by labor-saving devices and machinery. The adoption of machines is advantageous in concentrating responsibility for safety in a relatively few persons instead of many, as in older methods of mining, but, at the same time, maintenance and supervision must be intensified considerably, because the hazards are greatly increased in many ways.

Far too many coal mines are operated on the theory that coal mining is so inherently hazardous that accidents will inevitably continue to occur. Proof that coal mining can be conducted for long periods without fatalities and even without lost-time injuries is shown in table 8, which gives the records of mines that have worked 12 to 31 months without a lost-time injury.

TABLE 8. - Coal mines operating for more than 12 months without a lost-time accident

Mine	Operator	Location	Period	Duration, months	Men employed	Coal mined, tons	Exposure, man-hours	Remarks
Russellton...	Republic Steel Corp.	Russellton, Pa.	3/2/44 to 4/9/45	13	448	841,972	1,163,814	70% pillars, 35% mechanized.
Alloy........	Electro-Metallurgical Co.	Alloy, W. Va.	3/13/31 to 1/14/34	34	130	323,619	682,979	
Ingram Branch	Elkhorn Piney Coal Mining Co.	Ingram Branch, W. Va.	7/25/33 to 1/28/36	30	135	354,294	543,258	50% pillars, hand-loaded.
Dehue........	Youngstown Mines Corp.	Dehue, W. Va.	1/7/31 to 8/31/32	19-1/2	214	356,805	531,382	
Imboden......	Stonega Coke & Coal Co.	Imboden, Va.	3/20/31 to 7/8/32	15-1/2	198	231,469	509,232	
No. 4........	Union Pacific Coal Co.	Rock Springs, Wyo.	7/29/39 to 12/15/40	16-1/2	259	479,042	501,462	
Lewisburg....	Sloss-Sheffield Steel & Iron Co.	Birmingham, Ala.	12/18/34 to 8/27/35	8	511	384,232	564,649	
Davidson.....	Republic Steel Corp.	Connellsville, Pa.	3/2/37 to 4/5/38	13	291	328,288	462,043	Handloaded, 37% pillars.
No. 9........	U.S. Coal & Coke Co.	Lynch, Ky.	6/14/45 to 6/20/46	12	243	382,710	381,426	
"B"..........	Union Pacific Coal Co.	Superior, Wyo.	1/8/32 to 1/1/34 9/20/37 to 12/31/38	24 14-1/2	133 200	379,315 350,703	377,024 334,649	
Smaller Mines								
Hellier No. 2	Caudill-Ward Coal Co.	Hellier, Ky.	6/1/44 to 12/27/46	31	43	251,942	269,250	100% mechanized.
Mossboro.....	Black Diamond Coal Co.	Mossboro, Ala.	10/1/31 to 12/31/32	15	50	44,436	144,925	
City Coal....	Colorado Springs Co.	Colo. Springs, Colo.	1/1/39 to 12/31/40	24	75	76,919	170,864	
Steubenville.	Consumers Mining Co.	Steubenville, O.	1/4/31 to 1/9/33	12	84	128,630	230,732	85% pillars, 3-1/2-ft. coal.

The outstanding record in this table is that of the Russellton mine, Republic Steel Corp., Russellton, Pa., which operated for 13 months with 448 employees, working 1,163,284 man-hours in the production of 841,972 tons of coal without a lost-time injury. This record is more remarkable because it was made during the war, when the industry was handicapped by loss of the younger, and in many ways more capable, miners to the armed forces and to higher-paying war jobs, and the inability to replace or repair equipment, much of which was almost worn out or out of date. The record of this mine exceeds any known accident-free record in underground coal mining on the basis of both tonnage mined and exposure. This mine was operated on a 31-percent mechanical-loading and 69-percent handloading basis, and about 70 percent of the coal was from pillars.

Several of the mines in this group, employing up to 500 persons, had periods of injury-free operation exceeding 500,000 man-hours.

A separate tabulation of several small mines that had exceedingly fine records was included in this group to point out that coal mines with fewer than 100 employees can be operated safely. The Hellier No. 2 mine, Caudill-Ward Coal Co., Hellier, Ky., worked 31 months, with an exposure of 269,250 man-hours in the production of 251,942 tons of coal with an average of 43 employees without a lost-time injury from an operation 100-percent mechanized.

The Alloy Mine, Electro-Metallurgical Co., Alloy, W. Va., operated 34 months without an accident in mining 323,619 tons of coal in 682,979 man-hours. This is the longest accident-free period of any available record in the coal-mining industry.

The outstanding accomplishments shown in table 8 are much more impressive when it is considered that during the years the records were made, 1931-1946, from 94.93 to a minimum of 60.27 men were injured annually for each million man-hours worked, whereas 152.32 to a minimum of 82.71 men were injured annual for every million tons of coal produced in bituminous-coal mining in the Unite States as a whole.

Some very creditable no-fatality records have been established in the coa mining industry in the past 17 years. Not many years ago it was thought impos sible to mine a million tons of coal without a fatal accident; in a study of the no-fatality records in the files of the Joseph A. Holmes Safety Associatio it was found that 394 awards were given to coal mines for having mined more than a million tons without a fatality. Several of these awards were presente to the same mine in different years but should not be considered as duplicatio of an award, as each succeeding award was granted on either a larger tonnage o more man-hours of exposure. The 394 awards were divided as follows:

Million tons without a fatality	Number of awards
1 to 2	227
2 to 3	110
3 to 3-1/2	27
Over 3-1/2	40

Table 9 was compiled from the best records of mines that produced more than 3-1/2 million tons, those being selected that had both the largest tonnage and the greatest number of years of fatality-free operation. The mines in this table are fairly representative of the coal fields in the United States and under varied conditions of mining. The duration of the fatality-free records ranges from 2-1/2 to 21-1/2 years and from approximately 4-3/4 million to 10-1/2 million man-hours of exposure.

The best record in this table is that of the Ford Collieries Co., Curtisville, Pa., which worked for more than 9 years, or a total of 10,451,396 man-hours, in producing 7,770,654 tons of coal, This record is exceptional, as it was made from 1920 to 1929 in the early days of the safety movement, when relatively few coal mines paid much attention to safety.

The record of Mine 58, Peabody Coal Co., Taylorville, Ill., is one of the best of the known records established in recent years; this mine operated from June 1941 to March 1947, working 5,175,835 man-hours in the production of 7,031,035 tons of coal with 420 employees in a 100-percent mechanized mine without a fatality.

The longest known no-fatality record of large or medium-size coal producers was established by the Odin Coal Co., Odin, Ill., which worked over 21 years with a total of 8,120,834 man-hours in producing more than 4 million tons of coal.

The Penn Anthracite Mining Co., Scranton, Pa., worked for over a year and produced 2,027,461 tons of coal in a total of 5-1/2 million man-hours, an exceptional record for anthracite mining. During the time this record was being made, 4.5 men were killed for each million tons of anthracite mined by the anthracite industry as a whole.

The Pine Hill Coal Co., Minersville, Pa., was the first anthracite mine to produce a million ton of coal without a fatality insofar as shown by the files of the Joseph A. Holmes Safety Association; this record resulted from a definite safety policy adopted by the company, which included safety meetings, adoption of a safety code, and the enforcement of safe practices. Thirteen coal beds ranging in thickness from 3-1/2 to 16 feet and pitching 0 to 90 degrees were mined at this property.

Falls of roof or coal cause 50 or more percent of the fatalities and about 35 percent of the nonfatalities in coal mines year after year. It is one of the few causes in the prevention of which relatively little progress has been made in the coal mines of the United States. Table 10 was included in this paper to show that some mines have accomplished what is considered the impossible by far too many in the mining industry - the prevention, or at least the material reduction, of roof-fall accidents.

TABLE 9. - Coal mines having outstanding records of no fatalities

Mine	Operator	Location	Period	Duration, years	Men employed	Coal mined, tons	Exposure, man-hours	Remarks
	Ford Collieries Co.	Curtisville, Pa.	8/14/20 to 10/2/29	9+	-	7,770,654	10,451,396	Hand-loaded.
Mine 58..	Peabody Coal Co.	Taylorville, Ill.	6/17/41 to 3/12/47	5-3/4	420	7,031,035	5,175,835	100% mechanized.
No. 2....	U.S. Coal and Coke Co.	Gary, W. Va.	7/11/39 to 4/15/44	4-3/4	666	6,770,083	6,504,389	
No. 6....	do.	do.	2/24/17 to 12/31/26	9-3/4	-	6,030,802	6,565,912	
	Northern Ill. Coal Corp.	Wilmington, Ill.	4/5/29 to 1/1/36	6-3/4	-	6,331,402	-	3 ft. coal bed.
Colonial No. 1....	H.C. Frick Coke Co.	Smock, Pa.	8/1/29 to 12/22/35	6-1/4	-	5,866,108	7,280,537	Handloaded, 75% pillars.
No. 3....	Superior Coal Co.	Mt. Claire, Ill.	11/29/38 to 2/1/46	7+	446	5,763,753	5,707,393	100% mechanized.
Nemacolin	The Buckeye Coal Co.	Nemacolin, Pa.	7/27/44 to 2/5/47	2-1/2	1,128	5,669,177	6,891,517	100% mechanized.
Monarch..	Sheridan-Wyoming Coal Co.	Monarch, Wyo.	12/3/24 to 10/26/41	16-3/4	192	5,220,209	-	100% mechanized; coal bed 18-28 ft. thick.
South Union...	South Union Coal Co.	South Union, Pa.	3/11/27 to 1/1/37	6-1/4	390	4,979,748	5,387,941	90% from pillar.
Odin.....	Odin Coal Co.	Odin, Ill.	9/14/07 to 1/1/39	21-1/4	-	4,095,087	8,120,284	
Somerset.	Calumet Fuel Co.	Somerset, Colo.	3/20/23 to 12/31/41	18-3/4	-	3,586,434	4,705,637	Pitch workings, gassy, thick coal.
Anthracite mines producing over 1,000,000 tons without a fatality								
Colliery.	Penn Anthracite Mng. Co.	Scranton, Pa.	11/15/33 to 1/22/35	1+		2,027,461	5,522,428	
Henry Col.	Lehigh Valley Coal Co.	Plains, Pa.	3/2/37 to 8/10/39	2-1/2	735	1,251,107	2,800,000	481 working days.
	Pine Hill Coal Co.	Minersville, Pa.	1/12/32 to 2/28/34	2+	750	1,147,146	3,485,008	
Maple Hill....	Phila. & Reading Coal & Iron Co.	Shenandoah, Pa.	8/13/43 to 1/1/45	1-1/4	1,477	1,009,240	3,841,516	

TABLE 10. - Coal mines that have operated without a lost-time roof-fall accident

Mine	Company	Location	Period	Duration, months	Coal mines, tons	Exposure, man-hours	Remarks
Columbia	Geneva Steel Co.	Columbia, Utah	9/1/45 to 3/1/47	18	525,924	722,534	100% mechanized.
All mines	St. Clair Coal Co.[1]	St. Clair, Pa.	8/1/32 to 1/1/34	17	410,000	1,804,383	Coal beds 4 to 20 ft. thick pitching 5 to 90 degrees.
			1/1/32 to 12/31/32	12	632,553	1,286,806	
Wildwood	Butler Consolidated Coal Co.	Wildwood, Pa.	9/32 to 12/33	15	762,012	921,204	
Lawrence	Madeira Hill & Co.[1]	Mahonoy Plains, Pa.	3/21/32 to 10/25/33	19	329,877	1,005,427	Coal beds 1-1/2 to 25 ft. thick pitching 0 to 65 degrees.
	Colonial Colliery Co.[1]	Natalie, Pa.	1/1/39 to 12/31/39	12	605,561		
	Consumers Mining Co.	Harmarville, Pa.	1/1/38 to 12/31/38	12	805,120		Only 1 accident.

[1] Anthracite mine.

It is interesting to note that with a few exceptions the records shown in tables 8, 9, and 10 were made before World War II, several before 1935, when both the fatality and nonfatality rates were considerably higher than for the past 6 or 7 years. A definite reason cannot be given for this, but it may be due to decline in training and discipline in the past 10 years. Prior to 1937 or 1938, most coal-mining companies provided first-aid training for their employees, but since the passage of some laws, which were interpreted as penalizing training, plus the effect of the war in restricting the holding of meetings to conduct training because of fatigue of workers, shortage of gasoline, and other travel restrictions, first aid and other types of safety work in and around the mine disappeared almost entirely. It has been definitely proved that first-aid training is one of the best methods of interesting the mine worker in safety and making him safety conscious; hence, the very great decrease in this work during the past decade has had a decidedly detrimental effect upon certain types of mine accident-prevention work.

PETROLEUM

While some branches of the petroleum industry have not shown the improvement in safety of operation during the past 10 years that other branches of the mineral industry have shown, yet frequency and severity of accidents for the industry at large is low in comparison with the other branches of the mineral industry, and there are those who claim that an irreducible minimum is being reached. Unquestionably, the petroleum industry as a whole has done well in reducing both accident frequency and accident severity under what they were 20 or more years ago, and the industry as a whole is decidedly safety conscious The outstanding safety records that follow tend to disprove the belief that further progress cannot be made, and until most companies in the industry at least approach these records there is room for improvement and the irreducible minimum is still a goal rather than an accomplished fact (table 11).

MISCELLANEOUS

Holmes awards have occasionally been given to companies that have attained remarkable improvement in their safety record by inaugurating and vigorously applying a definite accident-prevention campaign. These companies, although not as yet having accident-free records give excellent proof of what can be attained in accident reduction through well-devised safety programs participated in by everyone, from top management down, and enthusiastically carried out.

The Monarch quarry of the Colorado Fuel & Iron Co. at Garfield, Colo. reduced the severity of its accidents from 5.9 in 1939 and 4.1 in 1940 to 0.18 in 1945 and 0.08 in 1946 by a campaign that eliminated many of its more serious hazards.

A safety campaign at the Longview plant of the Reynolds Metal Co. of Longview, Wash., resulted in a reduction in the frequency and severity of accidents from 92.4 and 4.8 in 1945 to 38.7 and 0.6 in 1946.

The United States mine of the United States Mining, Refining, & Smelting Co. at Bingham Canyon, Utah, by consistently applying a comprehensive code of rules for safe operation, steadily reduced the accident-frequency rate from 83 in 1941 to 21 in 1946 while also lowering the severity rate from 18.3 in 1941 to 0.39 in 1946.

TABLE 11. - Petroleum operations having outstanding records with no lost-time accidents

Division	Company	Location	Period	Duration	Number of men	Man-hours worked
Manufacturing dept.	Esso Standard Oil Co.	Baton Rouge, La.	4 div. 3 to 8 years		433	6,038,562
Butane plant.......	Neches Butane Products Co.	Port Neches, Tex.	12/5/46-6/17/47	8 mo.	1,079	1,205,586
Norco refinery.....	Shell Oil Co.	Norco, La.	1/1/46-8/1/47	1 yr. 7 mo.	680	2,012,603
Fort Worth plant...	Sinclair Refining Co.	Fort Worth, Tex.	8/1/41-1/31/48	6 yr. 6 mo.	116	1,559,395
Eight divisions....	Stanolind Pipe Line Co.	Tulsa, Okla.	To 1948	1 to 3-1/2 yrs.	1,500	6,095,632
Thirteen districts.	Lone Star Gas Co.	Dallas, Tex.	To 1948	2 to 19 yrs.	268	4,206,014
Louisiana division.	Standard Oil Co. of New Jersey	Baton Rouge, La.	7/29/46-11/14/46	108 days	8,187	4,216,014
Wewoka area........	Stanolind Oil & Gas Co.	Wewoka, Okla.	9/16/38-2/22/47	8 yrs. 4 mos.	80	1,505,266
Ingleside refinery.	Humble Oil & Refining Co.	Ingleside, Tex.	8/8/40-12/7/41	1 yr. 4 mos.	563	1,687,433
Wood River refinery	Standard Oil Co. of Indiana	Wood River, Ill.	8/27/38-6/30/42	4 yrs.	1,000	6,897,296
Southwest Louisiana	United Gas Pipe Line Co.	Lake Charles, La.	11/14/37-11/25/45	8 yrs.	80	1,214,568
		No-fatality records				
All departments....	Carter Oil Co.	Tulsa, Okla.	1/1/42-12/31/45	4 yrs.	1,928	16,008,714
Tulsa division.....	Gulf Oil Corp.	Tulsa, Okla.	4/25/38-12/31/46	7 yrs. 6 mos.	2,000	37,446,337
Field employees....	Gulf Oil Corp.	Tulsa, Okla.	12/25/35-12/31/46	11 yrs.	854	22,528,061

These three cases are cited as examples from among the several in the files of the Association, and there are many equally fine records in the mining industry that show that safety efforts do "pay off."

In addition to the above listed awards, the Association has, upon three occasions, used its prerogative to recognize highly meritorious service by certain individuals and has expressed this recognition by granting special awards, as follows:

On April 16, 1946, to George Samuel Rice, a Medal of Honor for untiring efforts and successful leadership in forwarding safety in the mineral industries of the United States and for being a pioneer in safe mining and one of its foremost leaders for 40 years. His consistent efforts in advancement of mine safety, and particularly his fundamental study in causes and prevention of mine explosions, have contributed greatly in making mines in the United States bette places in which to work.

On May 20, 1947, to A. J. R. Curtis, a Medal of Honor for outstanding leadership in connection with the remarkable safety record maintained more than 25 years by the approximately 125 member plants of the Portland Cement Association. Largely as the result of his continuous efforts, more than 70 of the plants have operated for a calendar year or more without a lost-time accident, and at least 21 have been accident-free for more than 2,000 days.

On April 20, 1948, to Daniel Harrington, upon his retirement as Chief of the Health and Safety Division of the Bureau of Mines and after 21 years of service as secretary of the Joseph A. Holmes Safety Association, a Medal of Honor, for his spirited guidance and tireless effort in forwarding the aims and objectives of the Association and for his lifetime devotion to the advancement of safety and health in the mineral industry.

CONCLUSIONS

The records established by the mines, companies, and individuals reported herein indicate that the number of accidents in the mining industry can be very greatly reduced. Many of these mines have shown that accidents can be prevente for long periods. These records resulted from intelligent planning, intense effort and training on the part of management, and the cooperation of workers who believed that accidents can be very largely avoided. The mines and individuals establishing these safety records have shown what can be achieved by education and the willingness of all concerned to work together in a joint effort to benefit not only all persons in the mining and allied industries but al the general public.

The records shown and discussed in this paper indicate what can be done and have more or less established a goal for the whole mining industry to surpass or equal; certainly, the mining industry can do as well in the future as it has done before, and, with equal certainty, the coming years should bring safety accomplishments far exceeding those achieved in the past.